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Proposed Minimum Water Level Criteria for Lake Okeechobee, the Everglades, and the Biscayne Aquifer within the South Florida Water Management District

Appendix F

Supplemental Environmental Information

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APPENDIX F - MFLS SUPPLEMENTAL ENVIRONMENTAL INFORMATION

Lake Okeechobee

EFFECTS OF HIGH/LOW LAKE STAGES.

Table F-1 provides a detailed matrix of the effects of high and low water levels on the Lake Okeechobee ecosystem. This information is broken down into a series of high and low water level categories, bracketing what is considered the optimal range (12 to 15 ft NGVD) of seasonal water level fluctuations for the lake. **Table F-1** provides documented evidence regarding the effects of a particular water level range and its impact (both positive and negative) on the ecology of Lake Okeechobee. **Figure F-1** is a bathymetric map that can be used to determine which areas of the lake are exposed at various water levels.

These data do not however, explicitly address the issue of return frequency or duration of flooding or drying. For the effects listed, it is assumed that the magnitude of the impact will increase with increased duration or return frequency of events. It is important to recognize the effects listed here are “direct” effects of high or low lake levels. Under conditions when lake levels are high, it is also likely that nutrient inputs from the watershed will also be elevated. This change in nutrient status could also impact ecosystem attributes. These additional effects are not considered here, but are described in the document entitled “Lake Okeechobee Conceptual Model and Hydrologic Performance Measures” (Havens and Rosen 1997).

Everglades

"INDICATOR REGIONS"

Figure F-2 provides a graphic of the location of specific "Indicator Regions" within the Everglades system as used in the Natural Systems Model (NSM) and the South Florida Water Management Model (SFWMM). Indicator regions are defined as groupings of model grid cells within the NSM and SFWMM identified by similar vegetation coverage and soil type. These smaller subareas were developed to average model output over a larger, multiple groupings of similar cells, rather than looking at a single (2 X 2 mile) cell represented by a single water management gage.

Table F-1. Matrix of Effects of High and Low Water levels on the Lake Okeechobee Ecosystem.

Water Level or Range	Ecological Effects	Information Base (numbers in parentheses refer to a reference list attached to this table)
>17 ft (at this lake level, entire littoral zone is flooded with water depths ranging from 2-5 ft. deep depending on location)	**Negative Effects:** 1 damage to bulrush and critical fish habitat at lake shore and littoral fringe due to wave erosion 2 loss of submerged aquatic vegetation due to insufficient light penetration 3 Loss of spikerush communities, expansion of cattail, increase in torpedo grass at higher elevations of the marsh 4 increased circulation of nutrient & sediment-rich water from mid-lake to near-littoral zone 5 increase in lake-wide total phosphorus concentrations, possibly due to greater net internal loading 6 higher phosphorus concentrations in water discharged to downstream ecosystems 7 transport of nutrients into pristine areas within the littoral zone, with nutrient-induced shifts in periphyton and plant community structure 8 extensive loss of nesting and foraging habitat for wading birds 9 reduced reproductive success for alligator populations 10 loss of willow habitat (preferred wading bird and snail kite nesting areas) with prolonged flooding 11 loss of habitat for certain mammals (e.g., bobcats) 12 reduced germination of native plant species in areas that are inundated for long periods of time 13 loss of habitat for Okeechobee gourd, a federally-endangered plant **Positive Effects:** 14 reduced germination of melaleuca and torpedo grass	1 observations of wave impacts and comprehensive fisheries surveys by FGFWFC (1) 2 plant survey data from high water period and lab experiments (2) 3 vegetation studies documented by Milleson (8) 4 statistical analysis of water quality data and hydrodynamic model output (3,4) 5 statistical analysis of w. quality data (3) 6 statistical analysis of water quality data (3) 7 hydrodynamic model output and results of nutrient-addition mesocosm experiments (4,5,6) 8 results from Lake Okeechobee Ecosystem Study (LOES) (7) 9 information provided by FGFWFC staff from yearly alligator nesting surveys 10 results from LOES (7) 11 preliminary results from District / USACE) study of animal use of littoral zone 12 documented by Milleson (8) 13 observations by District and USFWS staff 14 exp. research on melaleuca germination and growth (9) and influence of water depths on torpedo grass growth and biomass (10)
>16 ft (at this lake level, entire littoral zone is flooded with water depths ranging from 1-4 ft. deep depending on location)	**Negative Effects:** 1 Similar impacts as listed for > 17 ft. NGVD, except that the loss of bulrush community due to wave action (item 1) is not as great a concern at this water level **Positive Effects** 2 same effects as listed for >17 ft. level	see corresponding items above, under > 17 ft Category
>15 ft (entire littoral zone is flooded with water depths ranging from a few inches to 2-3 ft. deep depending on location)	**Negative Effects:** 1 Similar impacts as listed for > 17 ft. NGVD, except that the loss of bulrush due to wave action (item 1) is not as great a concern at this water level, and nutrient transport into the interior marsh (item 6) is less likely at this lake stage. **Positive Effects:** 2 same effects as listed for >17 ft. level	see corresponding items above, under > 17 ft Category

Table F-1 (Con't). Matrix of effects of high and low water levels on the Lake Okeechobee ecosystem.

Water Level or Range	Ecological Effects	Information Base (numbers in parentheses refer to a reference list attached to this table)
15 ft to 12 ft Range (approx. 50% of the time lake stages fluctuate between these two levels) At 12 ft. NGVD approx. 73% of the marsh is exposed as dry land	**Positive Effects:** Natural water level fluctuations in response to seasonal rainfall within this range are considered to ecologically benefit the littoral zone as well as other lake societal values (fishing, ecotourism, recreation, navigation). 1 optimization of prey resources for water birds 2 enhanced germination of native plants 3 reinvigoration of willow stands 4 facilitation of beneficial fires that can burn away cattail and torpedo grass 5 provide hydroperiods and water depths that will support spike rush (Eleocharis) communities in Moonshine Bay, a critical habitat currently threatened by torpedo grass expansion during dry periods. 6 peripheral bulrush habitat still has standing water and can be used as nesting and foraging habitat by largemouth bass and other recreationally important fish species. 7 increased light penetration results in the regrowth of beneficial submerged aquatic vegetation such as pond weed or eel grass when lake levels fall within the 12 –13 ft. range. 8 absence of many harmful effects associated with higher or lower lake levels **Negative Effects:** 9 when lake levels fall to 12 ft for extended periods, upper elevations of the littoral zone dry out and allow for the expansion of melaleuca, torpedo grass and other terrestrial species. Recent success in the melaleuca eradication program to date may, in part, be a result of lake levels not falling to these levels for the past several years.	1-4 Results from LOES (7) 5 GIS maps of littoral zone flooding, GIS vegetation maps, experimental studies at UF regarding torpedo grass growth under standing water (10) 6 see items 1 and 7 above, under the > 17 ft category 7 see item 2 above, under the > 17 ft category 9 observations of rapid melaleuca expansion following the 1989 drought, and results of experimental research at FAU (9) and UF (10)
<12 ft When Lake levels fall < 12 NGVD more than 73% of the marsh is exposed as dry land	**Negative Effects:** 1 Large regions of the marsh dry out and become available for invasion by Melaleuca, torpedo grass and terrestrial weeds 2 large areas of the marsh are no longer available as nesting or foraging habitat for fish, wading birds and other aquatic dependent wildlife. 3 Stabilized water levels within this range allow cattails to expand and out-compete bulrush and other native species within the littoral zone. 4 Increased predation of wading bird nests **Positive Effects:** 5 enhanced germination of native plants 6 reinvigoration of willow stands 7 increased frequency of beneficial fires that can burn away cattail and torpedo grass thatch 8 most of Moonshine Bay is still inundated, and the peripheral bulrush community is usable as a fishery habitat 9 improved water quality nearshore with increased light penetration resulting in the regrowth of beneficial submerged aquatic vegetation (especially in southern region of the lake) 10 migratory waterfowl (diving ducks) utilization of open water areas of the lake generally increases. 11 consolidation/oxidation of organic sediments which improve water quality.	1 see item 9 under the 12-15 ft category 2 results from LOES (7) 3-6 results from LOES (7) 7 see item 2 above, under the > 17 ft category 8-9results from LOES (7) 10FGFWFC waterfowl surveys of the lake 11FGFWFC studies of other Florida lake drawdowns

Table F-1 (Con't). Matrix of effects of high and low water levels on the Lake Okeechobee ecosystem

Water Level or Range	Ecological Effects	Information Base (numbers in parentheses refer to a reference list attached to this table)
<11 ft When Lake levels fall < 12 NGVD more than 94% of the marsh is exposed as dry land	**Negative Effects:** 1 nearly the entire marsh is available for invasion by melaleuca, torpedo grass, Brazilian pepper, and other exotic plants whose germination or growth is inhibited by standing water 2 most of the marsh can no longer function as a spawning habitat for fish, aquatic invertebrates, or other wetland biota 3 at this lake level, the Moonshine Bay region becomes dry, and can no longer function as a valuable fishery habitat, or as a habitat for the federally-endangered snail kite 4 at this level, the peripheral bulrush community is exposed, and can no longer function as an important habitat for bass and other economically-important fish. In addition, extreme low lake stages allow cattails to replace bulrush at the outer fringes of the marsh. 5 at low lake stages snail kite nesting and foraging success on the lake are significantly reduced. 6 significant increase in the frequency of severe fires which consume wetland vegetation, soils and wildlife habitat **Positive Effects** 7 same as above for the < 12 ft. category	1 see item 9 under the 12-15 ft category 2 observations of animal use of different regions of the marsh 3 GIS maps of littoral flooding and exposure; observations animal use of different regions of the marsh; information provided by USFWS regarding snail kite ecology 4 GIS maps of littoral flooding and exposure; information provided by FGFWFC regarding fish use of native plant communities (1) 5 Bennetts *et al.*1994 6 D. Fox, FGFWFC, personal communication | 7 7 see corresponding information above, under the <12 ft. category
<10 ft When Lake levels fall < 12 NGVD more than 99% of the marsh is exposed as dry land	**Negative Effects:** 1 Generally the same effects as at <11 ft, since critical regions of the marsh have already dried out at higher elevations of the marsh. Overall ecological effects are more severe per unit of time at this level, but scientific information in support of this view is lacking. 2 At low lake stages snail kite nesting and foraging success are significantly reduced. Historically (1981) many snail kites abandoned the lake and disperse to other areas when lake levels approach 10.0 ft or less. **Positive Effects:** 3 same as above, under the < 12 ft category 4 during extreme droughts shallow open water areas of the lake become critical foraging habitat for South Florida wading bird populations	1 see corresponding information above, under the <12 ft. category 2 Bennetts *et al.* 1994 4 David, (11); Zaffke (13)

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Figure F-1. Lake Okeechobee Bathymmetry

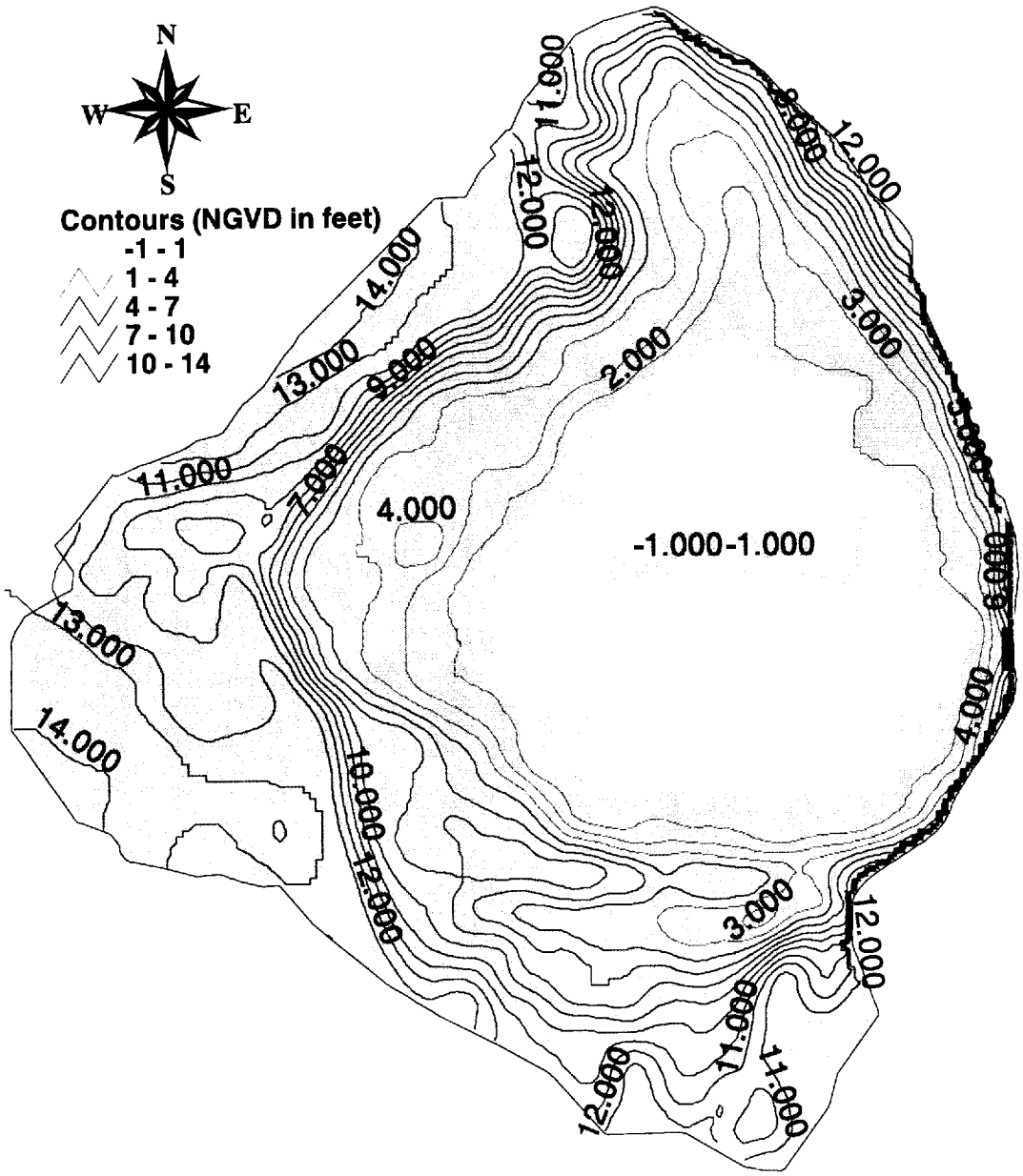

Figure F-2. Everglades Indicator Regions.